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INVESTIGATING CHANGES IN MATHEMATICS TEACHERS' INTENTIONS REGARDING WEB 2.0 TECHNOLOGY INTEGRATION

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Abstract: This research was conducted to examine factors affecting pre-service mathematics teachers' intentions to integrate Web 2.0 tools in their future teaching of mathematics. Thirty pre-service teachers who registered for the elective course within the department comprised the study group for the research. At the beginning, middle and end of the two-credit course, three semi-structured interviews, reflective journals and field notes were used to collect the qualitative data. The decomposed theory of planned behaviour was used to analyse the collected data. The results of this study showed that attitudes, subjective norms and perceived behavioural control explicitly influence pre-service mathematics teachers' intentions regarding Web 2.0 technology integration. In particular, pre-service teachers expressed their inclination to use Web 2.0 applications in their professional lives so as to develop student learning, communication, and share teaching materials. Although future mathematics teachers plan to apply Web 2.0 technologies in mathematics education because of pedagogical outcomes, they held the belief that successful integration of Web 2.0 is contingent upon the meaningful integration of these technologies with mathematics topics being taught and learning outcomes. This study presents some recommendations for educators who will prepare pre-service mathematics teachers to integrate Web 2.0 technologies within the teacher education program.

Keywords: intentions, future teachers, web 2.0, technology integration, mathematics education

1. Introduction

Technology is clearly changing and transforming the world we live in. This change is also visible in the educational process; it provides a variety of opportunities for stakeholders in the teaching process especially when designing teaching material and developing educational content. Web-based technologies are one of these opportunities. When educational activities in the 21st century are examined, Web-based educational technologies attract the curiosity and interest of many researchers and these technologies are expected to create a significant effect in the learning and teaching process (Bower, 2012; Jimoyiannis, Tsiotakis, Roussinos & Siorenta, 2013). As Internet technologies reach very large communities maintaining education and teaching activities becomes easier. In this way, in recent years educational organisations in many countries have performed studies to improve technology integration in schools. Examples of these projects include "Preparing Tomorrow's Teachers to Use Technology" (PT3) in the United States of America and "Teaching Teachers for the Future" (TTF) in Austria (Albion, 2014). One of the five components of the FATIH project implemented by the Turkish Ministry of National Education (MONE) in 2010 was ensuring and managing educational e-content (MONE, 2017). With the aim of making technology a basic component of teaching classes, web-based applications along with electronic content enriched by multiple environmental components in the form of audio, visual, video and animation supported this process (EIN, 2017; Yıldız, Sarıtepeci & Seferoğlu, 2013).

It is known that to achieve the target of being an information society and for teachers to create social learning environments with active participation, they need to have effective skills in using different

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types of technologies in lessons (Nelson, Christopher & Mims, 2009). However, teachers have not reached sufficient levels in terms of integrating these new generation technologies with teaching in the classroom (Dağ, 2016; Ekici & Yılmaz, 2013; Elmas & Geban, 2012) and it appears they have not received the necessary professional development to be able to use these tools effectively in teaching (Binghimlas, 2009). Pre-service teachers who have newly graduated stated they do not have sufficient levels of experience in using computer technologies in mathematics education (Kurz & Middleton, 2006). They stated they did not feel ready to use these technologies well in teaching after graduation (Lei, 2009; Terr, 2011). Additionally the Educational Information Network (EIN) web site was insufficient in supporting these teachers in terms of material. In this context, one of the important topics that must be mentioned is the teachers' intentions in benefiting from web technologies and using them in lessons (Sadaf, Newby & Ertmer, 2016) and how open they are to development and change related to this topic (Elmas & Geban, 2012).

As a result, it is important that teachers know how to use Web 2.0 tools not only for personal aims, but how to use them to develop and support students as they learn. One of the main elements necessary for successful technology integration is stated to be the teachers' intentions and personal beliefs (Ertmer, 2005). The study by Sadaf, Newby and Ertmer (2012) made the recommendation that it was necessary to prepare teacher development program to target these beliefs for pre-service teachers to successfully use Web 2.0 technologies in their future classrooms. As a result, teachers and pre-service teachers should be aware of the benefits, and at the same time believe in them, before applying these teaching technologies in their own classrooms (Baki, 2000).

According to Ertmer (2005), factors affecting the process of integrating technology into teaching environments may be collected under two main categories of internal and external factors. However, to reduce the effect of, or remove, internal factors (belief, attitude, self-confidence, etc.) requires a more significant, difficult and long process compared to external factors. It was identified that insufficient levels of support for teachers in terms of information, attitude and beliefs about technology negatively affect the process of combining it with learning and teaching (Baki, 2000). The current beliefs of teachers may be determinants in deciding how to integrate technological applications into teaching (Ertmer et al., 2012). Additionally it appears that teachers' attitudes against using computers and lesson planning skills directly affect their beliefs about technology integration into the learning and teaching processes (Lee & Lee, 2014).

It was stated that positive intentions of pre-service teachers about the use of technology in the classroom might predict successful technology integration in their classrooms (Yushau, 2006). As a result, primarily it is necessary to inform teachers about the use of internet technologies and to direct them towards positive attitudes and beliefs about web-based applications. Understanding the basis of different types of beliefs held by pre-service teachers is thought to play an important role in changing their intentions with regard to using Web 2.0 technologies and at the point of benefitting from it during class activities. In this context, determining the beliefs related to Web 2.0 applications of teachers with a role in planning lessons and revealing development of these is important due to the necessity of directing education in line with the identified requirements. Moving from this point, the aim of the study was to ensure pre-service mathematics teachers develop educational e-content related to mathematical education using Web 2.0 tools and to research the effect of changes in beliefs related to intentions about the use of digital technologies in future classrooms of the pre-service teachers who received the course.

1.1. Role of Web 2.0 in Education

The use of Web 2.0 tools is expected to have a significant effect on students' learning (Pascopella, 2008). Vaughan (2010) researching the efficacy of integration of Web 2.0 technologies into lessons refers to the presence of positive effects on active and cooperative learning activities especially. Opportunities to make access to information, working in groups, social interaction and feedback easier make the use of Web 2.0 opportunities unavoidable in the field of education (Alexander, 2006; Elmas & Geban, 2012; O'Reilly, 2007; McLoughlin & Lee, 2007; Thompson, 2007). When dealt with from this aspect, the use of Web 2.0 applications in educational activities makes it possible to carry all types of information and teaching content onto an easy and rapidly accessible platform. Rosen and Nelson (2008) stated that the

popularisation of Web 2.0 applications formed a new concept called "Education 2.0". Together with this concept, the researchers emphasised the usefulness of Web 2.0 technologies with the aim of creating and structuring knowledge in educational activities and proposed that these technologies will provide significant contributions to social constructivist learning environments (Bower, 2012). Web 2.0 technologies make students producers of their own knowledge with active participation, have potential to offer multiple opportunities like cooperative and peer-learning, and present an educational web environment supporting sharing of content and knowledge (McLoughlin & Lee, 2010; Pascopella, 2008; Ryberg, Dirckinck-Holmfeld & Jones, 2010; Shihab, 2008). In this context, interactive Web 2.0 environments complying with social learning ensure the possibility of students to adopt exploratory and research roles (Mason & Rennie, 2008). Additionally, Web 2.0 technologies carry the learning and teaching areas of students outside the classroom walls by creating a bridge between school, home and larger masses (Jimoyiannis et al., 2013). Another reason for motivation about the use of Web 2.0 technologies in education is that students already use these familiar tools commonly outside the classroom.

1.2. Decomposed Theory of Planned Behaviour

This study used the decomposed theory of planned behaviour (DTPB) model to understand factors that affect future mathematics teachers' intentions to use Web 2.0 technologies in their clasrooms. Developed by Taylor and Todd (1995), the DTPB is the most comprehensive model on a factor basis to understand intentions in the use of computers or technology. DTPB is an expanded version of the Theory of Planned Behaviour (TBP) proposed by Ajzen (1991). TPB is a behaviour theory designed with the aim of explaining and estimating human behaviour completed in a certain context. PBT states the primary explanatory factor in individual's completing a behaviour is intention; with the intentions of an individual explained by attitudes toward the behaviour, perceived social pressure (personal norms) and perceived behavioural control (Fishbein & Ajzen, 1975). For an individual to display a behaviour, firstly it is necessary to form an "aim related to behaviour". According to planned behaviour theory (PBT) human behaviour is affected by three beliefs. In this context, the study by Ajzen (1991) stated the factors affecting behaviour with an aim are under the effect of *behavioural*, *normative* and *control* beliefs (p.1). These beliefs at the same time form the results of the behaviour that will occur. According to Taylor and Todd (1995), DTPB model focuses on certain beliefs and factors affecting the use and adoption of technology. Additionally, the difference between the DTPB model compared to the TPB is that the researcher first focuses on investigating attitudes, subjective norms and perceived behaviour control. Then the researcher concentrates on decomposing them into belief-based indirect measures (*ibid*).

In this study, the DTP conceptual framework was used. Shiue (2007) stated this model explained the personal, organisational and social variables related to teachers' intentions to use teaching technologies (p. 429). One of the personal variables of attitude toward behaviour is linked to positive or negative personal beliefs of teachers in producing positive results related to the use of Web 2.0 technologies in mathematics education. While positive beliefs strengthen teachers' intentions to display behaviour, negative beliefs weaken teachers' desires to display the behaviour. The social variable of subjective norms is stated to represent how the expectations related to whether the use of technological tools is necessary or not in the classroom held by people, institutions or organisations important to the teacher affect the teacher's intentions and thus, behaviour. Finally this theory proposes that as control of use is taken by the teachers, they have higher intentions for the use of technology. Additionally, when teachers feel sufficient in teaching mathematics with Web 2.0 technologies and encounter fewer obstacles to their use, they think they have more control. As a result, DTP will aid in deepening our investigation of factors underlying the intentions of pre-service teachers to use Web 2.0 technologies in their future classrooms.

In the relevant literature, there is a variety of research investigating variations in terms of self-confidence, attitudes and beliefs of pre-service teachers at the end of education about the use of digital technologies. For example, the study by Tatlı, Akbulut & Altınışık (2016) gave 46 pre-service teachers course related to Web 2.0 tools. At the end of the study, a significant increase was identified in the technological pedagogical content knowledge of pre-service teachers. The future teachers participating in the course liked the powtoon, quiz maker and edraw max applications and stated they considered using them in their occupational lives. Additionally, among other studies on Web 2.0 self-efficacy

beliefs, it is possible to encounter studies revealing how efficient individuals are about the use of Web 2.0 applications (blog, wiki, video sharing sites and social media tools (Baran & Ata, 2013; Timur & Taşar, 2011). Chan (2015) determined the behavioural, normative and control beliefs of thirty teachers using dynamic software in mathematics education. These beliefs of teachers were stated to be used in the successful integration process of technologic tools within mathematics lessons. Additionally, they stated it was necessary to investigate the beliefs of pre-service teachers related to the use of technological tools in mathematics teaching when course was given to teachers about new technologies in a technology-supported learning environment. Though teachers' intentions related to different technologies have been researched in general, the number of unique studies researching the intentions and attitudes of pre-service teachers, future users, related to the use of Web 2.0 technologies is limited (Sadaf, Newby & Ertmer, 2012; Sadaf, Newby & Ertmer, 2016). According to the results of these studies, which contribute to our understanding of intentions of teachers related to the use of Web 2.0 technologies in the classroom, the motivations revealed in intentions to use these technologies in future classrooms and forming the basis of these beliefs are not clear.

However, one of the most important aims of teacher education program should be the positive intentions of pre-service teachers necessary to complete the targeted teaching. A teacher who knows the relationship between teaching and learning will inquire about their own beliefs and analyse whether teaching occurred in line with these intentions which is very important in terms of increasing the efficacy of teaching. As a result, studies related to occupational development are very important for pre-service teachers to be effective in developmental and teaching activities used in their classrooms in the future. Similarly, Ertmer (2005) provided education in how technology eases work in teaching to teachers and stated that technology integration in lessons was necessary to change intentions related to the use of technology. In this context, revealing the development and variation in beliefs related to Web 2.0 applications of teachers, with the role of lesson planner, and the necessity to direct education in line with identified requirements are considered important.

Determining the perceptions and intentions of pre-service teachers regarding technology integration will be beneficial and directive in terms of strengthening teacher education programs. Currently considering the efficacy of technology in the teaching-learning process, it is important to know the beliefs future teachers in the education process hold about benefitting effectively from these technologies in mathematics lessons. As a result, the DTPD model will aid in deepening our investigation of the factors underlying intentions of pre-service teachers to use Web 2.0 technology in future classrooms. In this context, the aim of this study is to investigate factors that affect future mathematics teachers' intentions to use Web 2.0 technologies in their classrooms.

1.2. Aim of the Study

The aim of the study is to ensure primary school mathematics pre-service teachers develop educational e-content about mathematics education using Web 2.0 tools and to research the effect of this education in changing beliefs related to intention to use Web 2.0 technologies of these pre-service teachers in their future classrooms. In line with this aim, the study attempted to answer the following questions;

1) How do future mathematics teachers define the factors that predict their intentions to use Web 2.0 technologies in mathematics education?

2) How do future mathematics teachers change their intentions while engaged in developing mathematical content with Web 2.0 tools?

2. Method

This research was designed based on the qualitative research methods. The objective of this study was to examine how they in such a professional learning setting formalise their intentions. A multiple case study design was used to explore mathematics teachers' beliefs related to intentions and to investigate the dynamics of teachers' intentions change.

2.1. Participants

The study group for the research comprised a total of 30 pre-service teachers, 19 female and 11 male, registered for the "e-content development in mathematics education (EDME)" lesson in 3rd year of the primary school mathematics teaching department, Faculty of Education in the autumn semester of the 2016-2017 academic year. These pre-service teachers were included in the research considering the principle of voluntary participation. The pre-service teachers participating in the study had not previously received education related to Web 2.0 tools. These pre-service teachers had completed the computer technology lesson in 1st year.

2.2. Web-based Model Course

This study, investigating the variation in beliefs related to intentions to use Web 2.0 technologies of pre-service mathematics teachers in their future classrooms, encompasses a section of the scientific research project organized by the university. In line with this, 30 pre-service mathematics teachers were given an applied web-based model course over 42 hours and the possible variations in beliefs were observed. When constructing the course program, Web 2.0 tools appropriate to mathematics teaching were used, and the program was supported by appropriate worksheets and activities. Over 14 weeks, a variety of Web 2.0 tools (like Prezi, Wordpress, Cacoo, Eddpuzzle, Powtoon, Plickers and Scratch) were presented and applied within the scope of the course. The aim of the course was to make students aware of the potential of Web 2.0 tools in mathematics education, to conceptualize the epistemological and pedagogical principles of web-supported mathematics education, gain proficiency in using Web 2.0 tools for web-supported mathematics teaching and to be able to prepare web-based mathematics projects and activities for the concepts and topics included in the mathematics teaching program. In the first week of the activities, pre-service teachers were informed about planned activities that would be completed during the lesson and semi-structured interviews about Web 2.0 tools were completed before the course. In the relevant weeks, within the scope of activities run in three stages in line with the areas of interest of three researchers from among the authors of the paper, education was given about which types of Web 2.0 tools may be used in the stages of preparation, presentation and evaluation within the lesson planning process for educational activities. In other words, in this course pre-service teachers learned how to benefit from Web 2.0 tools to create e-content, for example creating concept maps and animation, coding, preparing e-presentations using interactive presentation tools and using digital in-class applications. During the three-hour lesson each week, lesson explanations were given in a computer laboratory allowing each pre-service teacher the chance to use an individual computer. Activity examples related to the use of web tools in teaching mathematical concepts and in solving problem activities were a focus. Project homework for the lesson requested the students to design material for an application of a Web 2.0 tool explained in each of the three stages. The developed web-supported content was discussed in the class environment. During this process the aim was to develop the pre-service teachers' beliefs in a positive way.

2.3. Data Collection Methods

Three data generation instruments of observation, semi-structured interviews, and participants' reflections were used to examine the course participants' beliefs related with intentions to employ Web 2.0 tools in teaching of mathematics.The future teachers were requested to reflect on their intentions to use digital technologies in their teaching. As the tutor of the course, I acted as a "participant as observer", thus having the opportunity to observe and record their activities and reactions to these Web-based

activities throughout the sessions and then closely examine which of the perceptions are modified or remained the same throughout the sessions.

To understand the factors affecting the intentions of pre-service mathematics teachers in more depth and to obtain more detailed information, three semi-structured interviews were completed at the beginning, middle and end of the course with 10 future teachers. The final interview aimed to capture the outcomes of the Web-based model course, namely in terms of the changes in the future teachers' intentions to use Web 2.0 technologies, and the perceived value of Web 2.0 in teaching of mathematics. Each interview lasted nearly 20 minutes. Expert opinions were obtained about the two data collection tools prepared in this research.

2.4. Data Analysis

The basic aim of the content analysis is to access the concepts and correlations to explain the collected data. In this study similar data were brought together within the framework of behavioural, normative and control beliefs and were organised and interpreted in a form that readers can understand. To assess the internal consistency and compliance with the research question, validity and reliability studies were completed. The compliance of the categories created in content analysis with the process steps (internal validity) was investigated by two experts and categories were given their final form in line with this feedback. To determine whether coding was reliable or not, reliability analysis between researchers was used. Coding by two experts for text randomly selected from within interview texts and the consistency between the coding by the researchers were investigated. When calculating the consistency coefficient, codes with consensus, were divided by the total of codes with consensus and divergence and the fit coefficients were determined to be higher than 0.87 (Miles & Huberman, 1994). Moreover, multiple data sources and the method of triangulation were used to make the study more valid.

3. Results

In this study 14 weeks of intervention about the use of Web 2.0 tools were given to pre-service mathematics teachers. Before the Web 2.0-based education, it appeared that some of the future mathematics teachers did not have much information about what Web 2.0 tools were in general. For example, the teacher coded T10 used the statement *"Actually I never heard of such as thing as Web 2.0 before…"* which supports this opinion of pre-service teachers. Additionally, teacher T4 stated *"as far as I know Web 2.0 tools are animated things"* showing that the future teachers had limited knowledge about Web 2.0 tools. Some pre-service teachers believe that Web 2.0 tools were related to social sharing networks. For example, teacher T9 stated *"When you say Web 2.0 something like communication comes to mind. Like, you share something and get an opinion from others. Like Instagram and Facebook. I think they are Web 2.0"* supporting this view.

In this study investigating factors predicting intentions of pre-service teachers to use Web 2.0 technologies before and after the course, DTPB was used. In this context, the behaviour of future teachers was investigated in three categories of attitude, subjective norms and perceived behavioral control directing behaviour and forming this model. The intentions of pre-service teachers about using Web 2.0 tools according to DTPB are given below.

3.1. Attitude

Behavioural beliefs cause the production of positive and negative attitudes about behaviour. In this context, behavioural beliefs are encountered as attitudes directing behaviour. In this research before and after Web 2.0-based course, the behavioural beliefs of future primary school mathematics teachers appeared to be related to their attitudes about the use of Web 2.0 tools. However, the behavioural beliefs directed by the attitudes of future teachers were determined to differ after Web 2.0-based course. Themes occurring related to the attitude of future teachers are given in Table 1, comparing between the beginning and end of the EDME.

Table 1. Investigation of attitude before and after Web 2.0 based course

Before	After
Students' learning with Web 2.0 tools Usefulness of Web 2.0 tools	Students' learning with Web 2.0 tools Usefulness of Web 2.0 tools Teachers' planning of the teaching process using Web 2.0 tools

According to Table 1, future teachers had common attitude in terms of the usefulness of Web 2.0 tools before and after Web 2.0-based course. However, at the beginning of the EDME it is noteworthy that pre-service teachers used prediction-based statements about the usefulness of Web 2.0 tools. For example, T2 pre-service teacher used the predictive statement *"Generally it seems there are more advantages. As a process, duration of use..."* to express the ease ensured by using Web 2.0 tools in terms of time in mathematic lessons. However, after Web 2.0-based education, the same pre-service teacher stated *"At least the teacher begins to use time well. The student is no longer left with a teacher who continuously writes on the board. For the student the teacher's lessons begin to be attractive fun classes"* which appears to be an explanation rather than a prediction. For example, future teacher T8 used the statement *"As I said in our first interview about Web 2.0 tools. I'll say it again, it makes lessons easier, definitely reduces the time... For a presentation that would take an hour you need to give 10-15 minutes..."* which supports this view. The majority of pre-service teachers stated Web 2.0 tools provided great time savings after seeing how they are used and for this reason they would use them in their lessons. The most of teachers showed positive attitudes toward applying Web 2.0 technologies in their future classrooms and planned to use them, some showed balanced attitudes. After course, nearly all teacher candidates may be said to have intentions to use Web 2.0 tools positively affected by the usefulness of the tools. Pre-service teachers appeared to plan to use Web 2.0 tools in their occupational life by considering the ease afforded to the teacher in mathematics lessons and the ease of understanding for the students. Some teacher candidates stating they would not use Web 2.0 tools in mathematics lessons before course appeared to change their intentions related to use positively after course in terms of the usefulness of Web 2.0 tools. For example, future teacher T1 included the following expressions at the beginning and end of the course process about the use of Web 2.0 in their future classroom.

T1: "*I don't think it's right to explain the whole topic that way (with Web 2.0 tools). Firstly I think it's important to meet the students eye-to-eye, in other words the student should take the chalk into their hands at the board, I think they should."*

T1: "*The teacher will talk less and get less tired because the questions are written there… There are many benefits for the student. The size of the writing, the form of it or drawings, these will be perceived more easily or in other words it's very beneficial to show a thing in full…"*

At the beginning and end of the Web 2.0-based education process, another attitude that pre-service teachers had in common was about the students' learning. Pre-service teachers emphasized that the students are in the tangible period and stated that Web 2.0 tools are important tools to concretise mathematical topics. As a result, it may be said they had the intention to use Web 2.0 tools in future lessons as they will aid mathematics teaching. Additionally, pre-service teacher mentioned the development level of students and stated that Web 2.0 tools may be beneficial in the students' learning due to attracting the attention of students by using visual elements. All pre-service teachers believed that Web 2.0 tools would attract the students' attention more due to containing visual elements. Both at the beginning and end of the education process, pre-service teachers may be said to intend to use Web 2.0 tools to increase visuality. Some students participating in the research at the beginning of the Web 2.0-based education process appeared to intend to use them in mathematics teaching only to increase visuality. As a result they stated that Web 2.0 tools may be used mainly in the geometry learning domain. For example, T7 pre-service teacher at the beginning of the education process used the following statement supporting this idea *"Generally it's used in the verbal section, but I don't think there's much effect, but for the topic of geometry I think maybe it could have more effect on students about angles or I don't know using shapes like rectangles and squares, I think it will be more effective for the shape*

topic". Teacher candidates stated that Web 2.0 tools would be used more in the geometry moving from the idea that the geometry is a learning domain requiring more drawing and visual elements.

Similarly, T9 teacher candidate attracted attention to visuality *"I think for 3-dimensional things, maybe for geometry. Not every child can think in 3 dimensions. In other words they can't figure out what's at the back of some point in the front, like a prism maybe. You can show it to them, turn it around. I think it will be most useful for those sort of things. In other words I think more for geometry"*. Stating that it may be used to visualize three dimensional objects for students in geometry, but later may change the idea. Other teacher candidates appeared to have the intention to use Web 2.0 tools at the beginning and end of the education process, considering how they appeal to the visual sense in terms of the student's age group. However, after Web 2.0-supported education, it may be said that pre-service teachers had intentions about comprehensive learning of mathematics, as well as visuality in mathematic teaching. For example, T1 teacher candidate intended to use Web 2.0 tools for mathematic topics that students do not understand saying *"I think for me whatever is the topic they don't understand I'd go over that one. For example, the children don't fully understand some things in trigonometry, some forms. A poster could be prepared and I could give it and show it to the children. In other words, there are rigid forms, you know the child doesn't know where it comes from. Because we can't prove it there to the child".* Additionally, after the intervention pre-service teachers appeared to state that Web 2.0 tools would be useful in different learning areas apart from the geometry learning domain. For example, some pre-service teachers focused on the idea that it may be easily used in the numbers learning domain. It is considered that topics related to the number learning domain may be concretised by using Pawtoon and Prezi. As a result, after intervention pre-service teachers emphasised the necessity of using Web 2.0 tools in mathematic teaching for domains other than geometry. Stated differently, after intervention pre-service teachers may be said to have created intentions related to using Web 2.0 tools in many specific topics in mathematics. Additionally teacher candidates stated they would use Web 2.0 tools with different aims both within lessons and outside lessons. For example, pre-service teacher T3 emphasised that Web 2.0 tools may be used in interactive fashion outside of mathematic lessons with the statement *"Generally for communication, if I want to communicate with a distant student I would use it. For example on Google Hangouts, I can share on their own computer screen, you know I can show what they want on the screen and give remote education. We can reach each other. Eddpuzzle could be a bit more about lesson explanation, but Plickers you know you can do that more in class. Let's say the student opens and watches in their own home. For example you start a topic, like you're looking at proportions, everyone, like that evening goes home and watches and solves the problems. You look for example, Ayşe solved that problem wrong. You can learn those things…"*.

After Web 2.0-based course, teachers may be said to have changed their aims in using Web 2.0 tools. Together with this, it appears targets changed while designing the mathematic teaching process related to Web 2.0 tools. In fact after Web 2.0-based education it appears pre-service teachers explained how they would design the mathematic teaching process by giving details. For example, before the intervention process, teacher candidate T9 made the statement *"Like maybe I could use it during lessons. I try to explain by coming face-to-face more, it's more permanent apparently. I can explain myself better".* After course they revealed their intentions to use Web 2.0 tools in the future with the statement *"Actually I liked these programs for mathematics but I couldn't adapt well, like I said I wouldn't explain the topic like that because I thought I could be more active myself, but like I said Eddpuzzle, Screencast and Prezi, we created a video using those three which will be beneficial for student's individual work. Like I liked it. Prezi for example has an interactive focus… like it can be attractive, my presentation can have better flow, it can be more interactive with this tool compared to PowerPoint. Eddpuzzle for example is important for recording very good statistics for the teacher".* Similarly another teacher stated they would use Web 2.0 tools to make presentations while explaining mathematics topics and to assess students after they received Web 2.0-based training. Additionally, it may be said that pre-service teachers intended to use these Web 2.0 tools according to a certain plan when using them in mathematic lessons. Before the Web 2.0-based education pre-service teachers appeared not to have a plan about using Web 2.0 tools and after intervention they had a sketch plan for themselves. For example, they had beliefs about the use of Prezi to attract students attention by increasing visuality in the first 5-10 minutes of the lesson, later Pawtoon may be used for animation with the aim of giving examples from daily life. In the last stage of mathematic lessons pre-service teachers chose to use Eddpuzzle for students to solve

mathematics problems. Additionally, teacher candidates intended to use Eddpuzzle mostly in terms of feedback-correction under the scope of assessing students. It is noteworthy that some teacher candidates stated that of Web 2.0 tools they would use Prezi most in their future classrooms. T4 supports this view with the statement *"I think Prezi is a very nice program. In terms of mathematic teaching… like the students would like this for example. I think Prezi is more useful compared to PowerPoint"*.

3.2. Subjective Norms

Subective norms are an individual's beliefs about themselves based on perceived social pressure. Normative beliefs occur as social pressure on pre-service teachers due to meeting expectations of the social surroundings that influence the pre-service teacher. It was determined that intentions to use Web 2.0 tools were formed by pre-service teachers meeting expectations related to their social environment. According to teacher candidates, the expectations related to the social environment may be related to individuals or organisations related to school or to the present age. In this context, pre-service teachers may be said to intend to use Web 2.0 tools to meet the expectations of their social environment in mathematic teaching. In other words pre-service teachers appear to feel social pressure to use Web 2.0 tools in mathematic teaching. For example, all pre-service teachers thought that the use of Web 2.0 tools in mathematic teaching was expected of them in this age. In this context, they appeared to intend to use Web 2.0 tools in mathematic teaching to keep in step with the present age. Conforming with the present age was among subjective norms mentioned by future teachers both at the beginning and end of the course. Before and after Web 2.0-based education the subjective norms of pre-service teachers are presented comparatively in Table 2.

Table 2. Investigation of subjective norms before and after Web 2.0-based education

Before	**After**
Conforming with the age Social sharing	Conforming with the age Social sharing Communication with school-related people

When Table 2 is investigated, it appears pre-service teachers had common subjective norms at the beginning and end of the course as well as having different subjective norms after education. Before course pre-service teachers appeared to have intentions related to the age being an age of technology and as a result technology should be included in mathematics lessons. It is noteworthy that the common subjective norms of conforming to the age was more commonly mentioned compared to the other subjective norms. Especially after course, it was emphasised that using Web 2.0 in mathematics teaching would conform to the age. After intervention, T4 teacher candidate made the following statement about conforming to the age *"Actually, we didn't know how to use Web 2.0 tools before seeing them but it's very good that we saw them. I think these are topics someone studying mathematic teaching should know because we are going to need teachers with technology in the future. For now in this period even students make fun of teachers who don't know technology…"*. Similarly other pre-service teachers appeared to intend to use Web 2.0 tools to prevent criticism by other people whether students or related to the school in their professional life. Pre-service teachers stated the need to know and use technology as a mathematics teacher and appeared to have greater intentions to use the technological product of Web 2.0 tools after intervention.

When common subjective norms are examined, another belief encountered is that teacher candidates intended to use Web 2.0 tools to share material related to mathematics (e.g., poems, writing related to mathematics, etc.) on social media. Additionally pre-service teacher stated they intended to use Web 2.0 to share innovations related to mathematics. After intervention, pre-service teachers thought that the popularising effect of Web 2.0 tools was greater and that they will use them as teachers. In this context, they may be said to have intentions to use Web 2.0 tools considering the effect of interaction with students outside of mathematics lessons. For example, pre-service teacher T5 made the statement *"I want to share things about mathematics, let's say, on my own blog with Wordpress, with the students. On the internet, both my own students can see it and students around the world"* supporting the use of Web 2.0 tools in terms of social sharing. Additionally after intervention among beliefs that developed

was that communication could be created with clubs or societies related to mathematics with Web 2.0 tools.

A different subjective norms after intervention was encountered as interaction with mathematics with individuals related to the school. For example, pre-service teachers may be said to intend to use Web 2.0 tools to communicate with people related to the school. Teacher candidates considered they would use Web 2.0 tools to communicate notices related to mathematics to the school principal and parents or about misunderstood topics. Pre-service teacher T6 stated *"let's say a student's parent contacts me. The child can't solve the problem, can you explain it? I can hold up my camera in one hand and explain it just like that, I can reflect my screen onto their telephone, like they'll definitely understand because it's just like I'm beside them"*.

3.3. Perceived Behavioral Control

Beliefs related to behavioural control encompass beliefs about whether an individual's behaviour is under their own control or not. Perceived behavioural control are encountered as internal beliefs of pre-service teachers making the use of Web 2.0 tools easier or more difficult. The behavioural control beliefs of teacher candidates before and after Web 2.0-based education are given comparatively in Table 3.

Table 3. Investigation of perceived behavioural control before and after Web 2.0-based education

Before	After
Teacher's sufficiency in terms of knowledge-equipment	Teacher's sufficiency in terms of knowledge-equipment
Teacher's interest	Teacher's interest
Teacher's effort	Teacher's effort
External factors (principal, lesson duration,…)	External factors (principal, lesson duration,…)
	Structure of Web 2.0 applications

Before and after Web 2.0-based education, common beliefs were that teacher's sufficiency and interest in technological information equipment affected their intentions to use Web 2.0 tools. According to the pre-service teachers, it may be said they believed that for a teacher to use Web 2.0 tools in mathematics teaching, it is necessary to know the use of Web 1 tools. For example, before intervention pre-service teacher T5 supports this view with the statement *"For example we saw PowerPoint and whatever. This is something built on top of this, a little like using the internet environment we'll construct things. Like the teacher needs to know this"*. After intervention, it appeared that pre-service teachers stated they needed more advanced knowledge of the use of Web 1 tools. Additionally they stated that Web 2.0 tools had knowledge required as a precondition themselves. For example, pre-service teacher T1 stated *"for example, to be able to do Screencast, we need to know Prezi. Because if you can prepare a presentation you can record it"*.

It was determined which external factors such as principal and lesson duration affect the use of Web 2.0 while pre-service teachers used Web 2.0 tools in mathematics teaching. Before intervention teacher candidates stated external factors like the principal not giving permission, classes being crowded and not having computers in schools. After intervention, the external factors of teacher candidates changed slightly. For example some pre-service teachers stated that the level of the students would affect their use of Web 2.0 tools. In situations where the student's level is good, they may be said to intend to use Web 2.0 tools. Additionally, there were pre-service teachers who stated their use of Web 2.0 tools would vary depending on the topic. In fact, some teacher candidates stated they had not adapted to all of the Web 2.0 tools in mathematics lessons. As a result, it appears they determined the most beneficial Web 2.0 tools for mathematics teaching for themselves.

After course, it may be said that problems encountered with the structure of Web 2.0 tools affected pre-service teachers' intentions to use Web 2.0 tools. Especially the Web 2.0 tools being in English was frequently mentioned by the pre-service teachers. Pre-service teachers stated that if the Web 2.0 tools were in their native language it would ease their intentions to use them. For example, T9 stated *"Some programs were in English which was a negative for me. When we translated them to Turkish there was*

a failure with Google, when we translate the writing in original form, whole pieces were deleted. There were continuous failures. Like, maybe I won't be in favour of using them…". However, even though pre-service teachers experienced problems like insufficient technical knowledge of the teacher or infrastructure (e.g., internet, class, principal etc.) they still stated they would make an effort to overcome these and use Web 2.0 tools in mathematics teaching. As a result, some pre-service teachers may be said to intend to use Web 2.0 tools for every topic in mathematics under all types of negative conditions. In other words, it may be said that if the teacher wanted, they had intentions to make an effort to use Web 2.0 tools in mathematics teaching.

4. Discussion

This research was performed with the aim of investigating intentions related to attitude, subjective norms and perceived behavioural control beliefs of pre-service mathematics teachers about the use of Web 2.0 tools in mathematics teaching. In this context, the researchers gave Web 2.0-based course to the pre-service teachers. Their intentions related to the use of Web 2.0 tools may be said to be affected by attitudes, subjective norms and perceived behavioural control. This result of the research is consistent with the results of the study by Alezemi (2017) determining intentions of pre-service teachers about the use of Web 2.0 tools. Additionally, pre-service mathematics teachers stated that they would be inclined to apply Web 2.0 technologies in future mathematics instruction in a variety of ways and for different purposes. After pre-service teachers learn about Web 2.0 tools and how to use them, it may be said they planned to use them in mathematics teaching. After Web 2.0-based course, pre-service teachers had a greater tendency to want to use these tools.

Especially when the beliefs of pre-service teachers are investigated in terms of attitude, it is possible to say they had a greater tendency to intend to use Web 2.0 tools. Some pre-service teachers appeared to have intentions that a teacher-centred approach is better at the beginning of the Web 2.0-based education process. However, after the intervention these pre-service teachers had intentions to use Web 2.0 tools contrary to the traditional method of explaining lessons and this is one of the noteworthy results of the research. Stated differently, after intervention of pre-service teachers it may be said they developed a different attitude toward the use of Web 2.0 tools and intentions changed in favour of using Web 2.0. This change among pre-service teachers may be explained as being due to the belief that Web 2.0 tools will provide more contribution to the educational process in their professional experience after education. It may be said that the consideration that Web 2.0 tools will ease the educational process was effective in creating intentions among pre-service teachers to use them after the course.

Indeed, it is known that Web 2.0 tools ease the teaching and learning process (Sadaf, Newby & Ertmer, 2013). After intervention pre-service teachers were determined to have attitude including the planned use of Web 2.0 tools in mathematics lessons in their professional life. Additionally, before the course, the majority of teacher candidates believed that Web 2.0 tools may be used only in the geometry learning field; while after the course they believed that Web 2.0 tools would be beneficial in different learning domains apart from geometry. After the course, pre-service teachers appeared to intend to integrate Web 2.0 tools in lessons according to a defined aim. For example, pre-service teachers stated they intended to use Powtoon especially in topic explanations as it has an animation and video preparation construct. Indeed, a study by Baran, Canbazoğlu Bilici and Mesutoğlu, (2015) on the self-efficacy beliefs about Web 2.0 tools used the Powtoon application to provide information to students about video design and development and stated they would use these skills in their future occupations. Additionally the study related to Web 2.0 technology by Tatlı, İpek Akbulut, and Altınışık (2016) found that according to pre-service teachers apart from Web 2.0 tools being easy and effective material, the pre-service teachers intended to use Powtoon.

It was revealed that pre-service teachers had intentions to use Eddpuzzle more in their occupational lives from among the Web 2.0 tools. Pre-service teachers intend to use Eddpuzzle while students were solving mathematical problems. In fact, problem-solving has an important place in mathematics lessons. Pre-service teachers emphasised the importance of problem solving in mathematics lessons and intended to use the Web 2.0 tool of Eddpuzzle for problem solving in their future classrooms.

Among the other results of the research was the subjective norms among pre-service teachers that Web 2.0 tools should be used to conform to the current age. Pre-service teachers considered this age to be a technology age and stated they intended to use Web 2.0 tools. Additionally, teacher candidates may be said to intend to use Web 2.0 tools in their social lives to socially share information related to mathematics. In fact the study by Tavluoğlu (2013) identified that Web 2.0 tools intensely used in social life were also intensely used in professional life. In this research it may be said that pre-service teachers intended to use Web 2.0 tools with the aim of sharing related to mathematics in their social lives apart from in mathematics lessons. Indeed, one of the most important advantages of Web 2.0 tools is that teachers and students can leave their own classroom and share information on a global scale (Horzum, 2010). Additionally intentions related to conforming to the age and social sharing were encountered as subjective norms before and after the course. However, after intervention other subjective norms related to communication with individuals related to the school may be said to be among intentions of teacher candidates in using Web 2.0 tools. After pre-service teachers learned about Web 2.0 tools and how to apply them, it may be said they intended to use the Hangouts tool to communicate with parents or other people related to the school and explain things that were not understood in mathematics lessons.

After Web 2.0-based course, intentions of pre-service teachers limiting the use of Web 2.0 tools appeared as intentions related to perceived behavioural control. According to future mathematics teachers' intentions about the use of Web 2.0 tools are affected by both internal and external factors. Examples of external factors that affect their intentions to use them in mathematics lessons include the principal not being open to the use of technology and lack of infrastructure for the use of Web 2.0 tools in schools. Additionally, different to intentions at the start of Web 2.0-based course, the structure of Web 2.0 programs appeared to determine the intentions of pre-service teachers about using this technology in the research. This situation may be explained by technical problems encountered by pre-service teachers during Web 2.0-based course. However, over time pre-service teachers believed they needed to expend more effort to integrate Web 2.0 tools into mathematics lessons. This result of the research is similar to the study on the use of Web 2.0 tools by Sadaf, Newby and Ertmer (2012).

5. Implications

It is understood that a variety of Web 2.0 applications support teaching activities from the research performed. An important quality that all teachers should have is skills in developing content and preparing technology-supported teaching material necessary and sufficient for the relevant area. In this context, teachers and pre-service teachers using web-based tools in individual or group environments to create unique content will positively contribute to the effective use of technology. In the name of efficiently benefitting from this situation, it will be possible for teachers to include Web 2.0 applications in activities during lessons and to direct students. In this context determination of the beliefs of pre-service teachers, teachers of the future, about the use of Web 2.0 tools in mathematics education and directing course based on the identified intentions is important in terms of integration of these tools in teaching in classrooms in the future.

5.1. Limitations

This research is based on beliefs determining intentions of primary school pre-service mathematics teachers at Çoruh University about the use of Web 2.0 tools. This situation is limited by the generalisation of the research in similar studies researching intentions related to the use of Web 2.0 tools. Additionally, this research is limited to a Web 2.0 based 14 week course. Pre-service teachers may require more time to learn about Web 2.0 tools and how they may be used in mathematics teaching. Finally, this study is limited to Web 2.0 technologies at the moment. With the rapid development of technology, the intentions of pre-service teachers related to the use of Web 2.0 tools may change.

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